

## CLAIMS

What is claimed as new and desired to be protected by Letters Patent of the United States is:

1. A process for forming optical integrated circuits comprising:  
depositing a resist layer on a substrate having a positive resist characteristic to optical radiation and negative resist characteristic to an electron beam;  
forming optical structures in said resist by selectively exposing said resist with an electron beam; and  
forming a periodic structure outside of said optical structures which exhibits a photonic bandgap.
2. The process for forming optical integrated circuits according to claim 1, wherein said periodic structure is formed by:  
exposing said resist with an interference pattern of optical radiation, filling voids created in said interference pattern with a dielectric material; and  
removing said resist material to create a periodic structure having a photonic bandwidth.
3. The process for forming optical integrated circuits according to claim 1, wherein said optical structures are three dimensional with one of said dimensions being controlled by selecting a predetermined electron beam potential.
4. The process for forming optical integrated circuits according to claim 3, wherein said electron beam potential is selected to 0.5-20 kV.
5. The process for forming optical integrated circuits according to claim 1, wherein said optical structure is a waveguide.

6. A process for forming optical integrated circuits comprising:  
depositing a first resist which has a positive resist characteristic to ultraviolet light and a negative resist characteristic to an electron beam on a substrate;  
creating a pattern for defining an optical component on said resist by exposing said resist with an electron beam having an accelerating potential selected to control one dimension of said component;  
depositing a second layer of resist on said first resist layer following exposure of said first layer of resist by said electron beam;  
exposing said layers of resist with multiple interfering light beams forming an interference pattern in the resist layers;  
developing said layers of resist to create voids in locations exposed by said interfering light beams;  
backfilling said voids with a material having a high index of refraction; and  
dissolving said resist to produce a three dimensional periodic dielectric with a high index of refraction contrast.

7. The process for forming an optical integrated circuit according to claim 6, wherein said optical component is a waveguide.

8. The process for forming an optical integrated circuit according to claim 7, wherein resist is patterned using said electron beam to form one of an optical cavity resonator or switch.

9. A method for creating a latent image of a periodic structure with embedded defects comprising:  
preparing a first layer of resist, said resist being sensitive to both optical radiation and electron beam radiation;  
selectively exposing said first layer of resist with an electron beam in an imagewise fashion, where the electrons of said electron beam move at a velocity required to penetrate only a predefined thickness of the outmost regions of said layer of resist;  
depositing a second layer of resist sensitive to optical radiation;

exposing the resist multilayer to a plurality of coherent beams of optical radiation that form an array of nodes and antinodes corresponding to an interference pattern in the volume of said resist multilayer;

whereby said latent image of a periodic structure is formed in the volume of the resist multilayer created by said array of nodes and antinodes, which also contains said embedded defects created by said electron beam radiation.

10. A method of Claim 9, where said layer of resist is prepared by depositing its liquid form on a substrate and evaporating a solvent.

11. A method of Claim 9, where said resist has a negative contrast for said electron beam exposure.

12. A method for creating periodic structure with embedded defect comprising a method for creating a latent image of a periodic structure of Claim 9 followed by chemical development process where portions of the resists are selectively dissolved depending on their exposure.

13. A method for creating periodic structure with embedded defect in a material comprising a method for creating periodic structure with embedded defect of Claim 12 followed by backfilling the voids with said material.

14. A method of Claim 13 followed by removing said resist.